Unit 11: Nervous System and Tissue

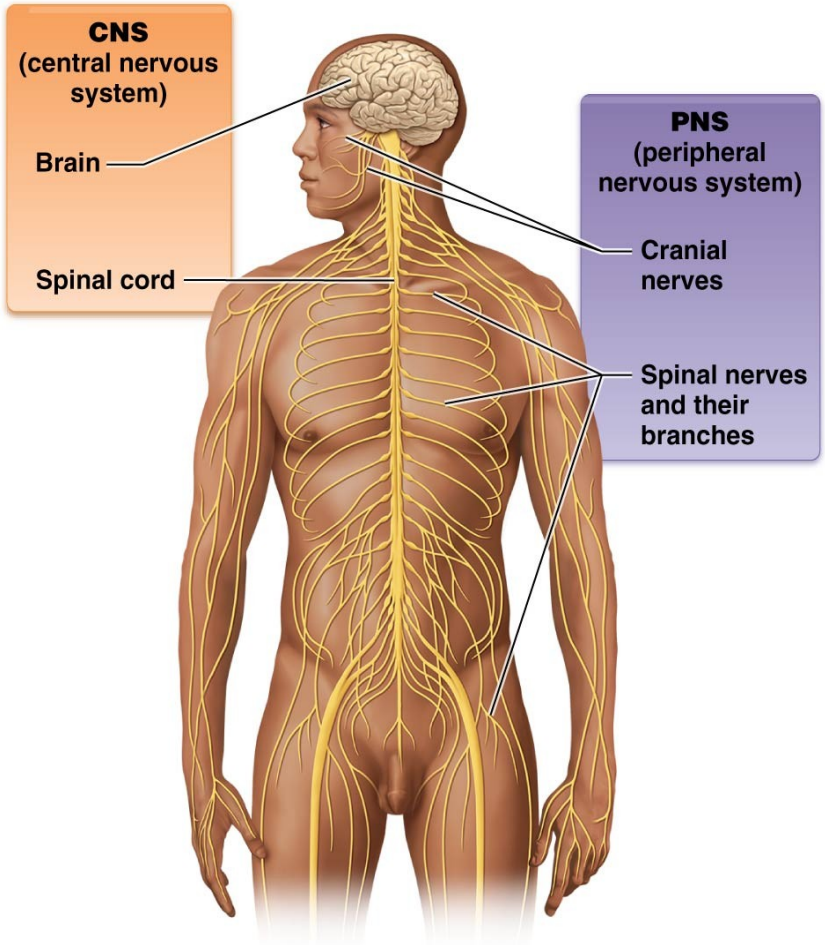
Nervous System: Your Body’s Super-Highway

- **Central Nervous System (CNS)**: The bossy CEO of the body, chilling in the brain and spinal cord, telling everyone else what to do. Think “control center.”

- **Peripheral Nervous System (PNS)**: The delivery guy, nerves delivering messages between the CNS and the rest of the body. They’ve got “routes” – cranial and spinal nerves – to make sure signals go to and from the brain and spinal cord.

Organization

- CENTRAL (CNS)
  - Brain
  - Spinal cord
    - Integrating and control center
- PERIPHERY (PNS)
  - Nerves
    - Spinal nerves
      - Carry impulses to and from spinal cord
    - Cranial nerves
      - Carry impulses to and from the brain
    - Spinal cord
    - Ganglia
    - Neuron cell bodies
  - Sensory
    - -relays to CNS (afferent)
  - Motor
    - -relays from CNS (efferent)



Lab Activity 11A, Figure 11.2, pg. 314

Nervous Tissue

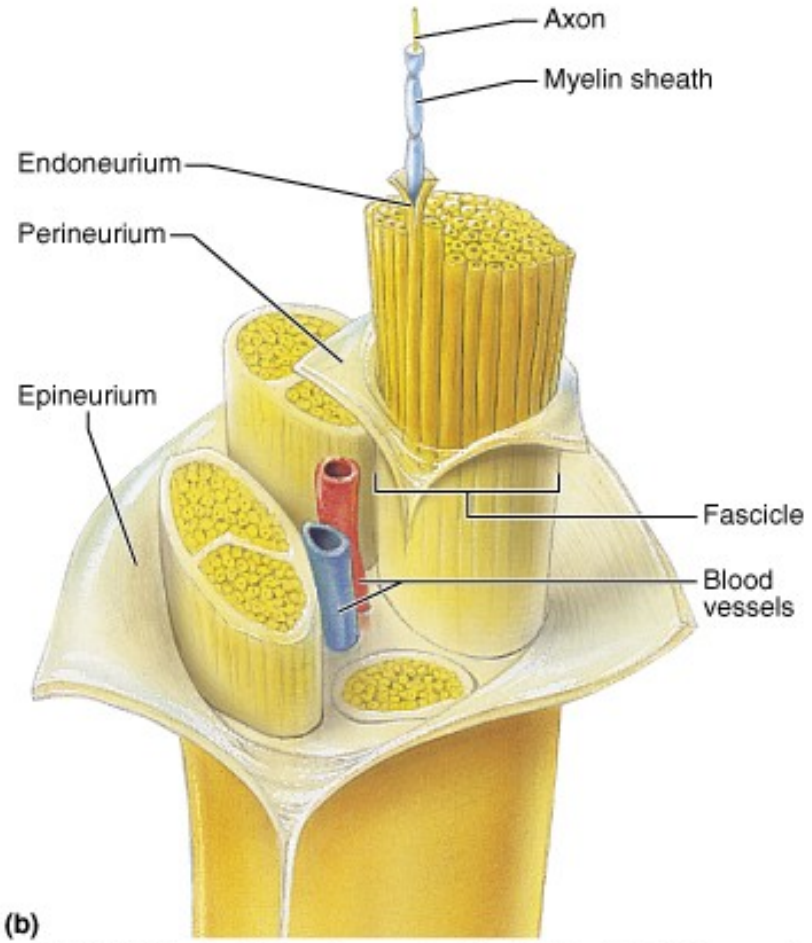
Tissue Talk – Three Bouncers of the Nerves

- 3 Types of tissue surrounds and compartmentalizes nerves
  - 1) Epineurium
    - Surrounds nerves

    Bouncer for the whole club (entire nerve)
  - 2) Perineurium
    - Surrounds nerve fascicles

    VIP ropes around nerve “fascicles” (bundles)
  - 3) Endoneurium
    - Surrounds individual neurons

    Bodyguard for each neuron.



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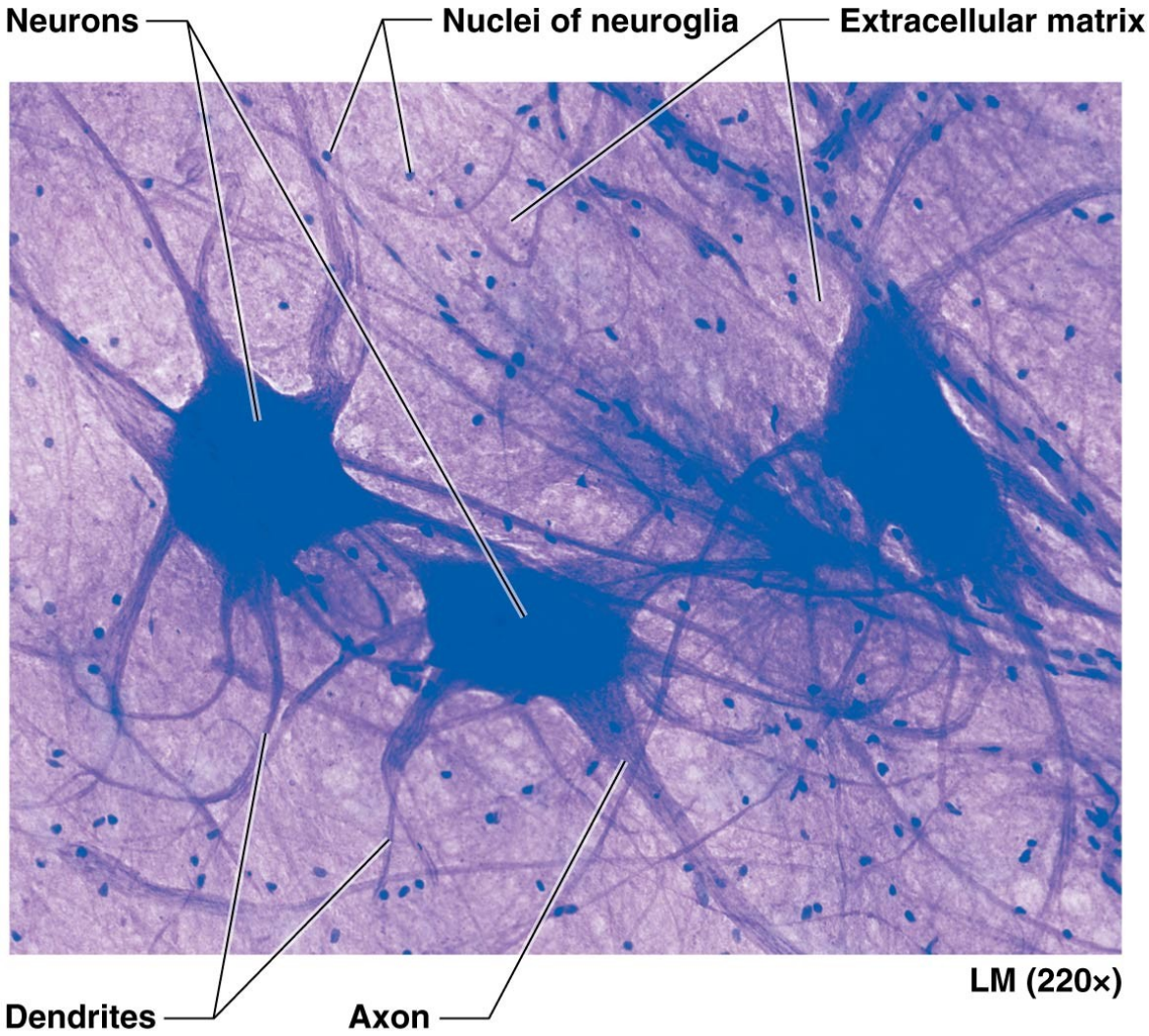
Nervous Tissue

- Nerves are organs composed largely of nervous tissue
  - Nervous tissue is made up of two populations of cells
    - 1) Neurons
      - (impulse conducting)
    - 2) Neuroglia cells
      - (supporting)

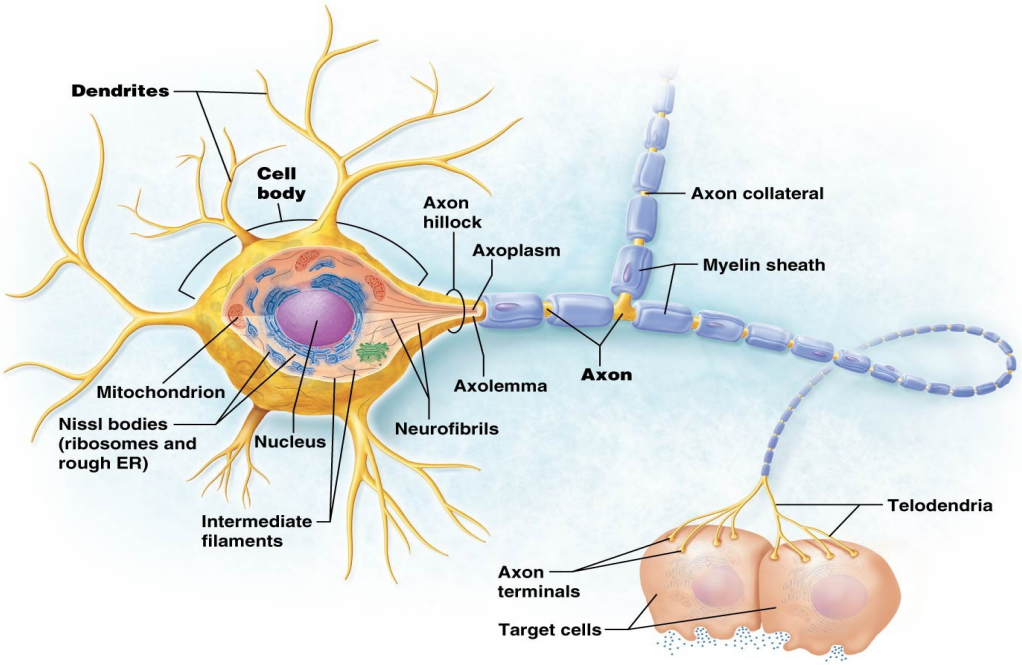


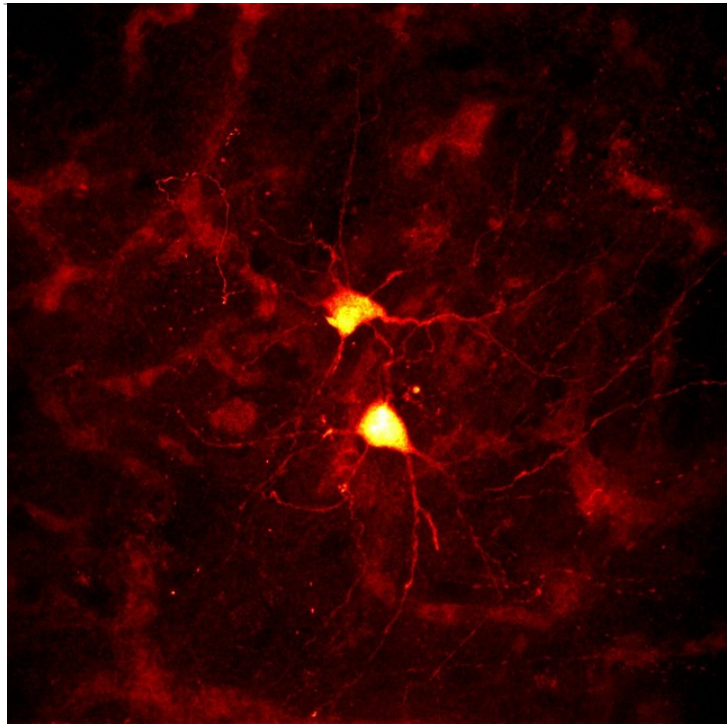
Lab Activity 11A, Figure 11.4, pg. 315

Neurons

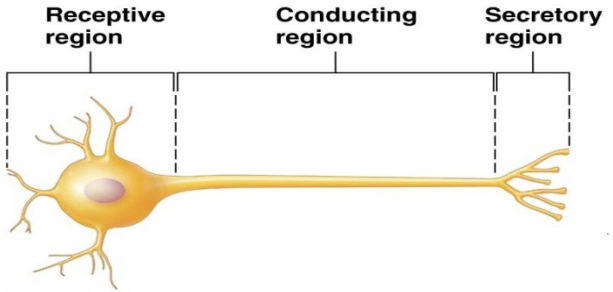
Neurons – The Divas of Signal Transmission ⚡

- **Dendrites**: Like satellite dishes; they're here to "catch the vibes" (receive stimuli).
- **Axons**: Roadrunner style! They zip electrical impulses through the neuron highway.





SEM: Finch neuron Activity in these cells controls the phonology of bird song.

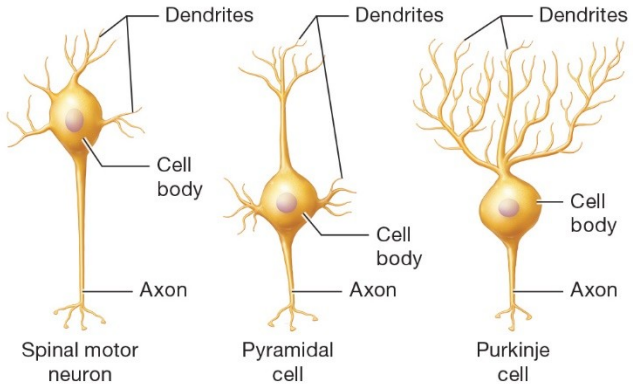
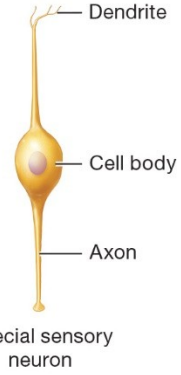
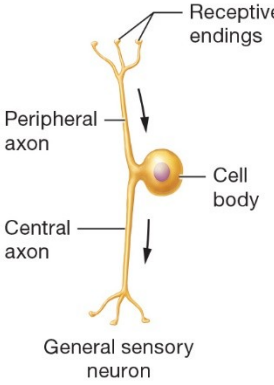


Lab Activity 11A, Figure 11.3, pg. 315

Neurons

- Structure
  - Multipolar
    - major type in CNS
  - Bipolar
    - rare/specialized sensory
  - Unipolar
    - primary in PNS

Table 11.1 Neuron Classification

Structural Class	Multipolar Neurons	Bipolar Neurons	Pseudounipolar Neurons
Structural Features	One axon with two or more dendrites; typically have highly branched dendritic tree	One axon and one dendrite	Single short process that splits into two axons (no dendrites)
			
Typical Functional Class	Motor (efferent) neurons, interneurons	Sensory (afferent) neurons	Sensory (afferent) neurons
Location	Most neurons in the CNS, motor neurons in the PNS	Special sense organs in the PNS, such as the retina and olfactory epithelium	Sensory neurons in the PNS associated with touch, pain, and vibration sensations

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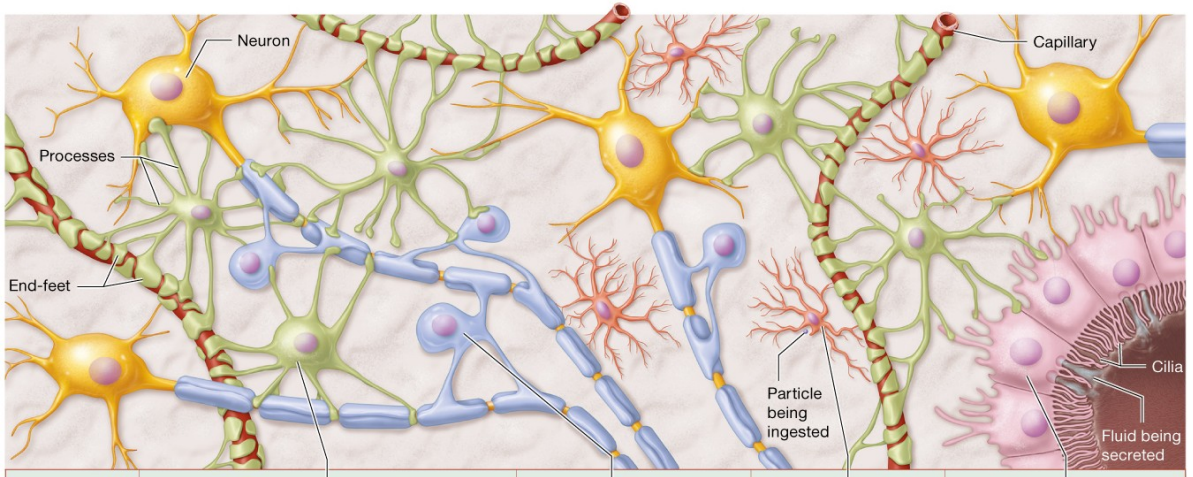
Lab Activity 11A, Table 11.1, pg. 317

Neuroglial cells

- **Neuroglia – Neuron Nannies**

1. **Astrocytes** (CNS): The neuron glue and helper.
2. **Oligodendrocytes** (CNS): Myelin makers, aka the neuron insulators.
3. **Microglial cells** (CNS): Tiny security guards, ready to fight intruders.
4. **Ephendymal cells** (CNS): The cerebrospinal fluid wizards.
5. **Schwann cells** (PNS): Also myelin makers but outside the CNS.
6. **Satellite cells** (PNS): Neuron babysitters keeping the environment just right.



NEUROGLIAL CELL TYPE	ASTROCYTE	OLIGODENDROCYTE	MICROGLIAL CELL	EPENDYMAL CELL
FUNCTION	• Anchor neurons and blood vessels • Regulate the extracellular environment • Facilitate the formation of the blood brain barrier • Repair damaged tissue	• Myelinate certain axons in the CNS	• Act as phagocytes	• Line cavities • Cilia circulate fluid around brain and spinal cord • Some secrete this fluid

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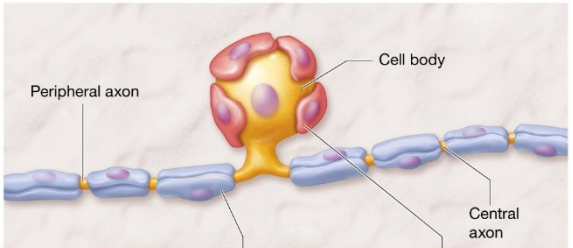

NEUROGLIAL CELL TYPE	SCHWANN CELL	SATELLITE CELL
FUNCTION	• Myelinate certain axons in the PNS	• Surround and support cell bodies

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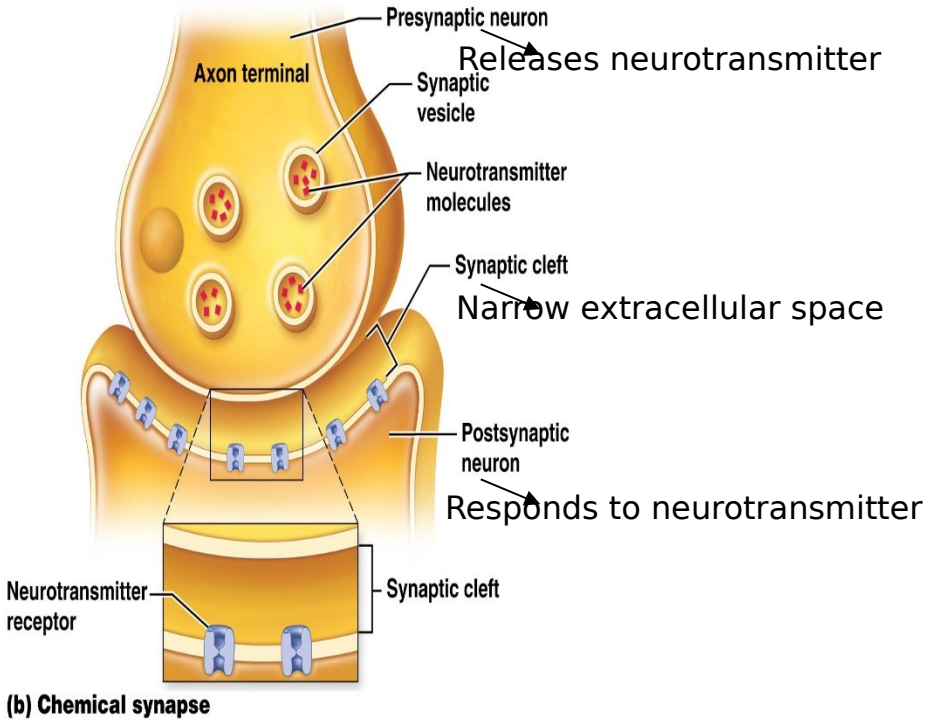
Lab Activity 11A, Figures 11.7 and 11.8, pg. 318

Chemical Synapses

A **chemical synapse** is where neurons send messages to each other (or to muscles or glands) by using chemical signals called **neurotransmitters**.

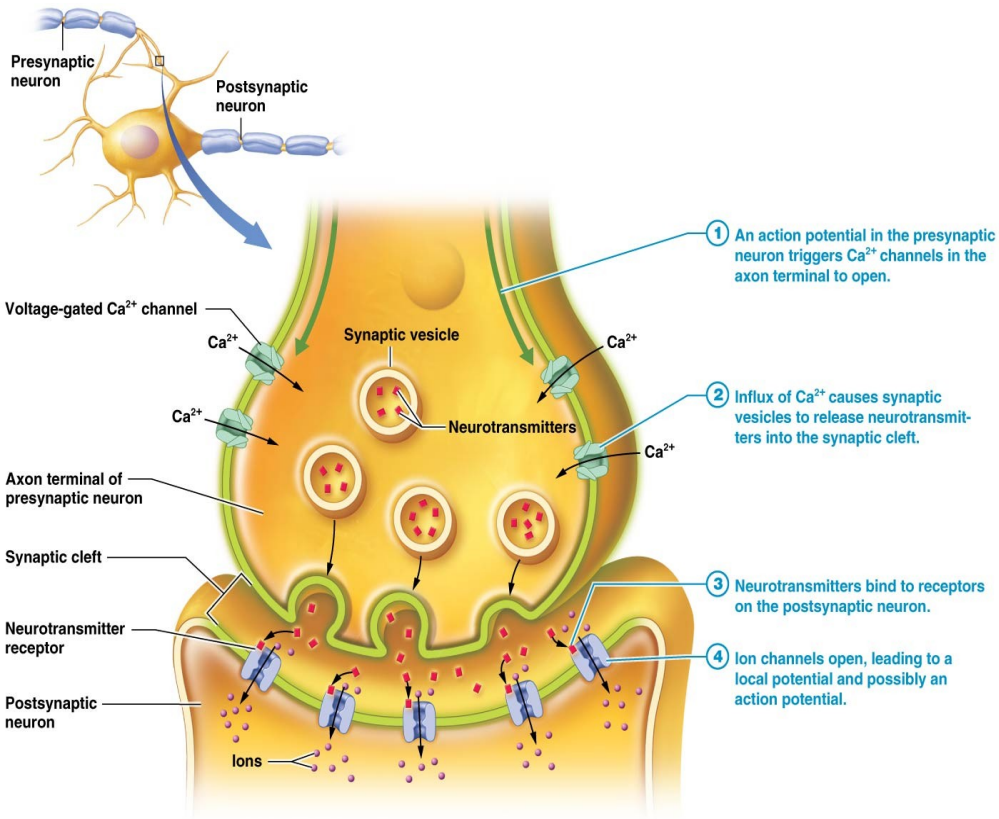
- Synapses
  - Junction between a neuron and another neuron or effector organ
- like post offices for neurons, where neurotransmitters deliver signals across tiny gaps, keeping communication going throughout the nervous system.



Lab Activity 11C, Figures 11.11and 11.14, pg. 321

Example: Touching a Hot Stove 🔥

1. **The Trigger – Sensing Danger** 🔥
You accidentally touch a hot stove. Special receptors in your skin, called **sensory receptors**, sense the heat and pain. They quickly send a message (an action potential) through sensory neurons up to your spinal cord and brain, saying, “Ouch! Danger!”
2. **The Arrival of the Signal (Action Potential)** ⚡
In the spinal cord, this “ouch” message needs to be quickly processed so you can react. The action potential reaches the end of the sensory neuron and triggers **voltage-gated calcium channels** to open, allowing calcium (Ca^{2+}) ions to enter. This is like a big "ready, set, go!" for the neuron.
3. **Neurotransmitter Release – Passing the Message** 📩
Calcium ions push tiny bubbles called **synaptic vesicles** (which are full of neurotransmitters) to the edge of the neuron. These vesicles release neurotransmitters (like a messenger carrying “move your hand now!”) into the **synaptic cleft** (the gap between neurons).
4. **The Big Leap – Crossing to the Next Neuron** 🚀
The neurotransmitters float across the synaptic cleft and bind to receptors on a **motor neuron** (the neuron that will make you move). This message handoff is like passing a note that says, “Time to move that hand!”
5. **Message Received – Motor Neuron Activated** 💪
On the motor neuron’s side, the neurotransmitters bind to receptors. This binding opens ion channels, creating a new action potential in the motor neuron. The signal is clear: “Move away!”
6. **Signal Continues – Contracting Your Muscles** ⚡
The action potential zips down the motor neuron to reach the muscles in your hand and arm. When it arrives, the muscles get the signal to contract and pull your hand away from the hot stove – fast!


Presynaptic neuron
Postsynaptic neuron
Voltage-gated Ca^{2+} channel
Ca^{2+}
Synaptic vesicle
Ca^{2+}
Ca^{2+}
Neurotransmitters
Ca^{2+}
Axon terminal of presynaptic neuron
Synaptic cleft
Neurotransmitter receptor
Postsynaptic neuron
Ions
1 An action potential in the presynaptic neuron triggers Ca^{2+} channels in the axon terminal to open.
2 Influx of Ca^{2+} causes synaptic vesicles to release neurotransmitters into the synaptic cleft.
3 Neurotransmitters bind to receptors on the postsynaptic neuron.
4 Ion channels open, leading to a local potential and possibly an action potential.

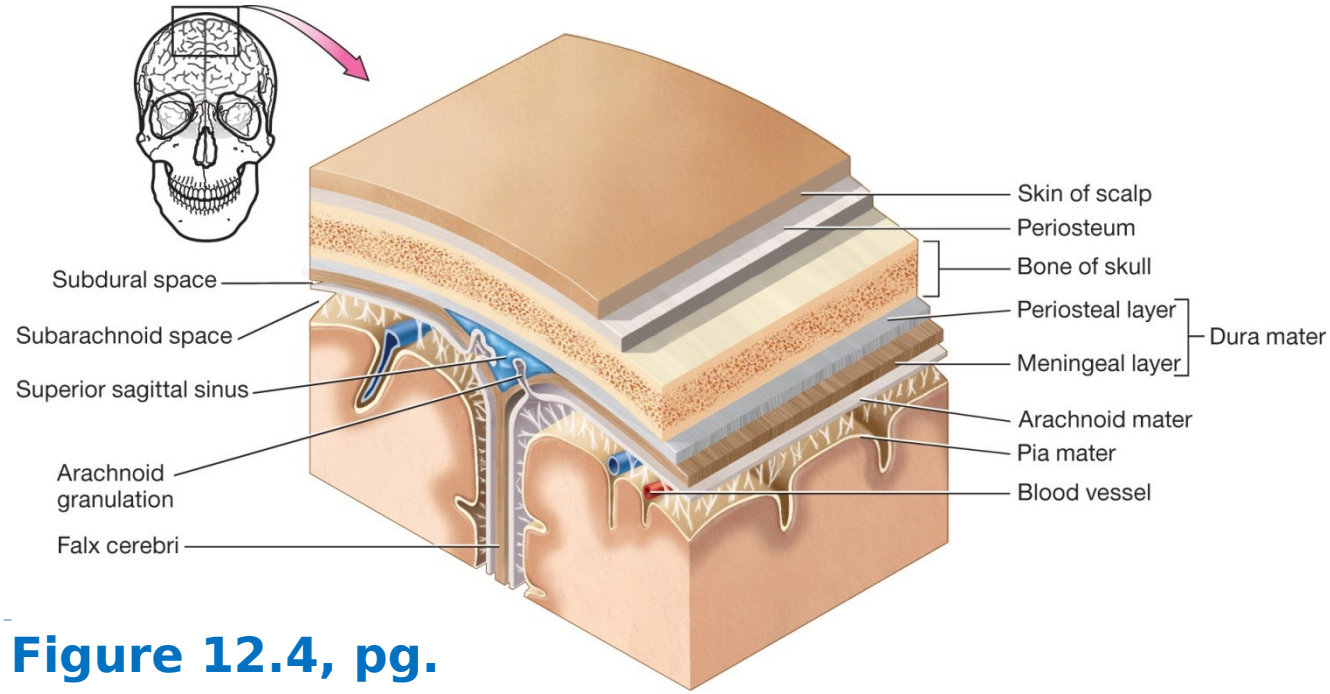
Unit 12: Central Nervous System

The Meninges

- 3 main layers protect the brain and spinal cord
- **The Meninges: Brain's Personal Bodyguards**

1. **Dura Mater**: Tough outer coat, no nonsense.
2. **Arachnoid Mater**: Spider-webby, chillin' in the middle.
3. **Pia Mater**: The hugger, sticking close to the brain.

- Between the layers you have the subdural space (between dura and arachnoid) and the subarachnoid space (between the arachnoid and pia)



Lab Activity 12A, Figure 12.4, pg. 332

Brain

1. Cerebrum is 83% of brain volume; cerebral hemispheres, gyri and sulci, longitudinal fissure, corpus callosum

Handles all the big thoughts and movement plans.

2. Diencephalon
    a. Thalamus
    b. Hypothalamus
    c. Epithalamus

3. Brainstem is the portion of the brain that remains if the cerebrum and cerebellum are removed:

Keeping us alive with heartbeat and breathing – the behind-the-scenes hero.

    a. Midbrain
    b. Pons
    c. medulla oblongata

4. Cerebellum contains 50% of the neurons; second largest brain region, located in posterior cranial fossa

Coordination pro. Dancing? Sports? Thank your cerebellum!

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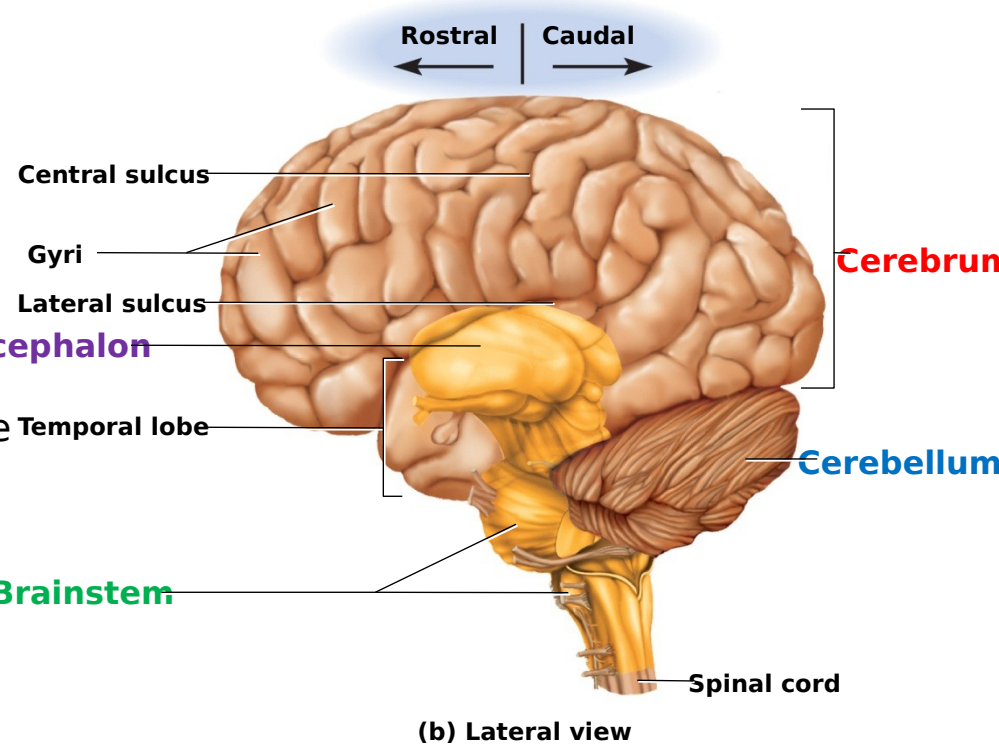
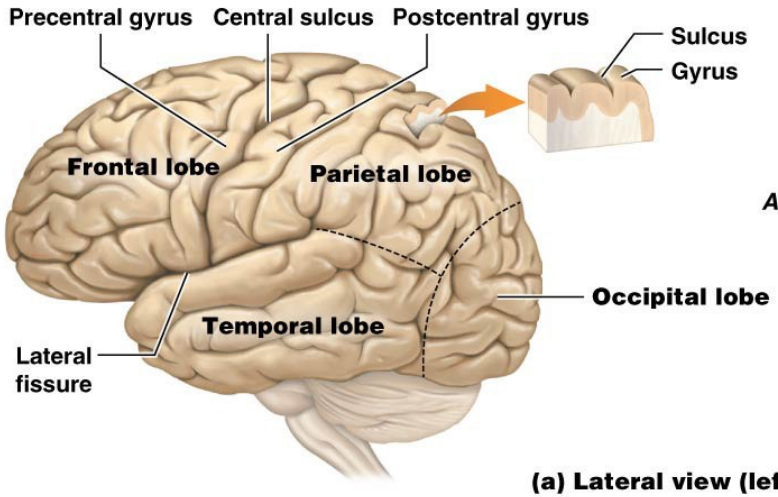
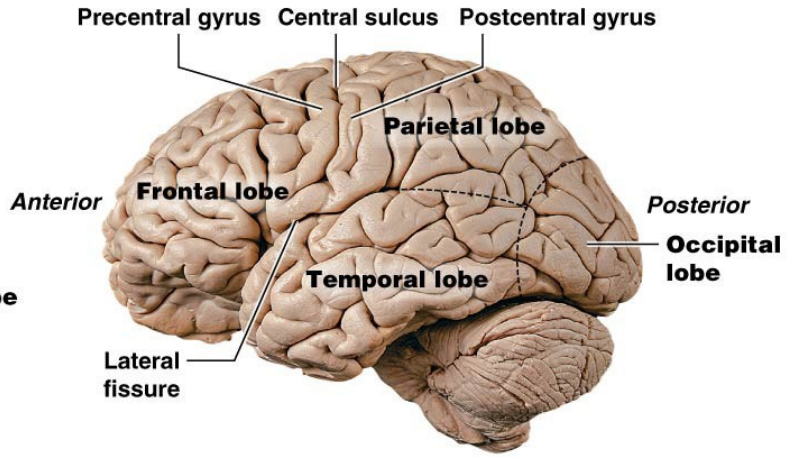


(b) Lateral view

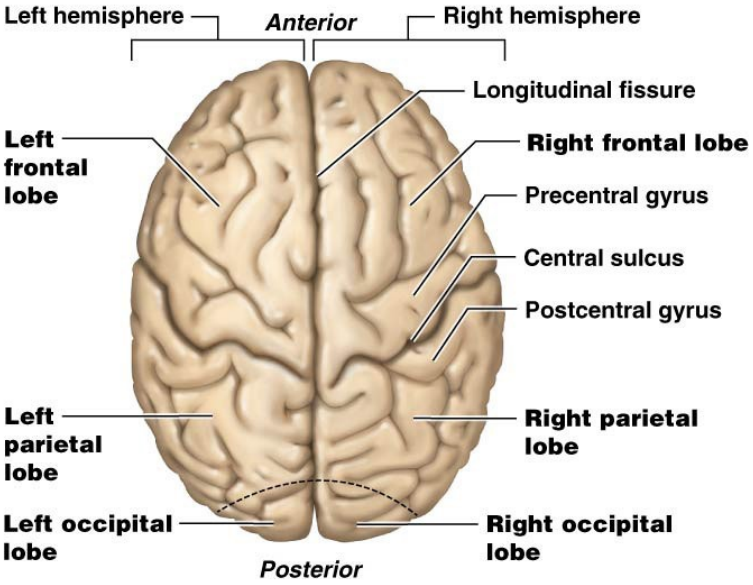
Lab Activity 12A, Figure 12.3, pg. 332

Brain

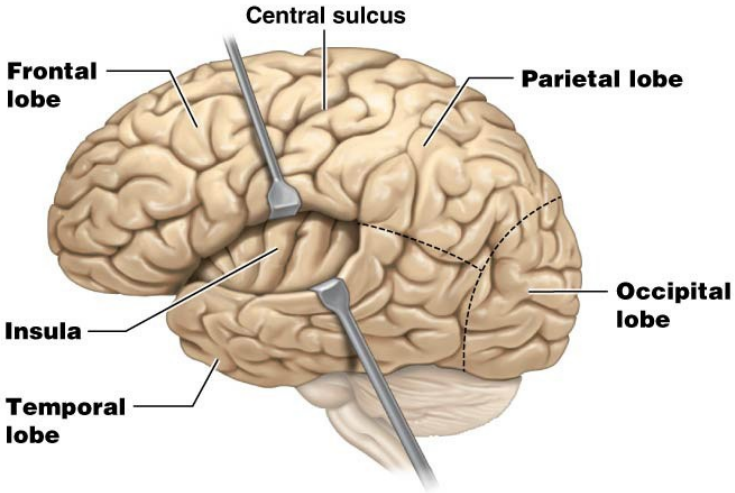




(a) Lateral view (left hemisphere)



(b) Superior view



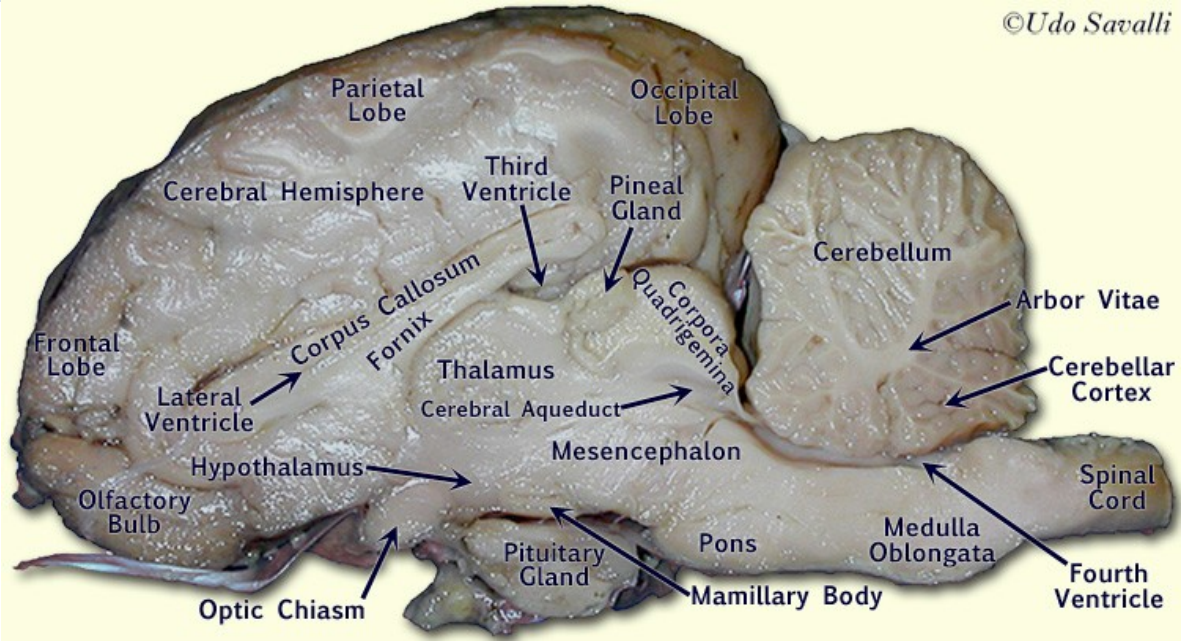
(c) Lateral view (frontal, parietal, and temporal lobes pulled back)

- **Lab Activity 12A, Table 12.1, Figure 12.5-12.16, pg. 333-340**

Sheep Brain

Know how to identify the following structures:

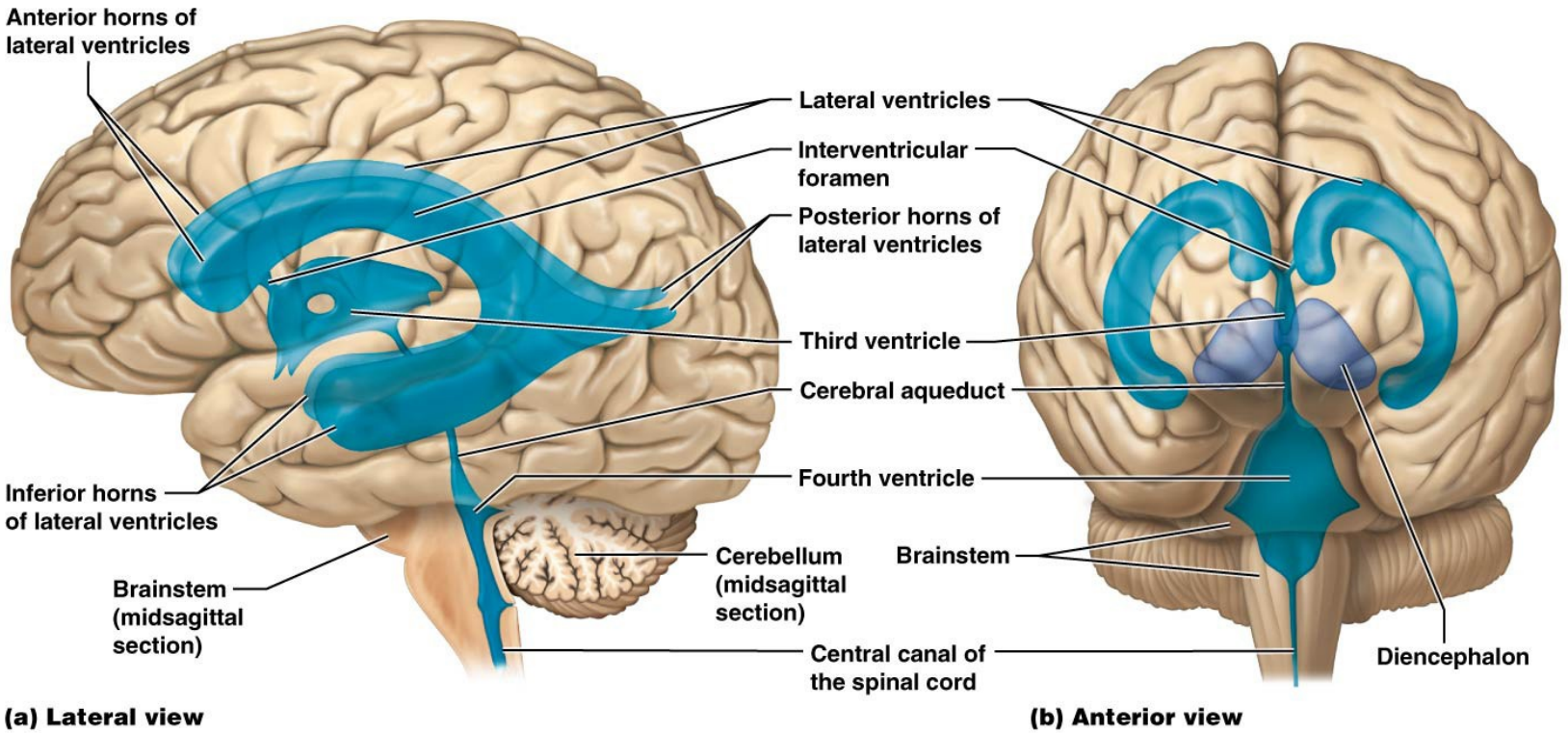
- Arbor vitae
- Corpus Callosum
- Fornix
- Optic chiasma
- Pons
- Medulla
- Spinal Cord
- Cerebrum
- Cerebellum
- Midbrain



Lab Activity 12A, Table 12.1, Figure 12.5-12.16, pg. 333-340

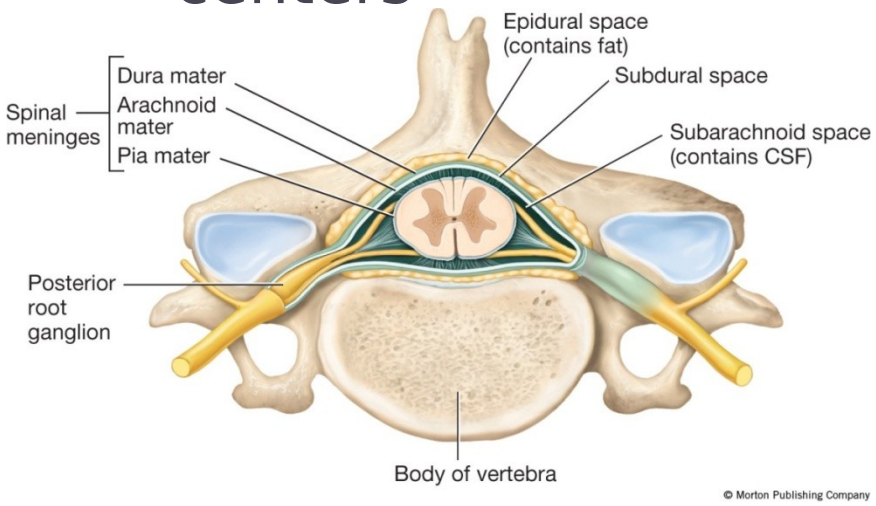
Ventricles

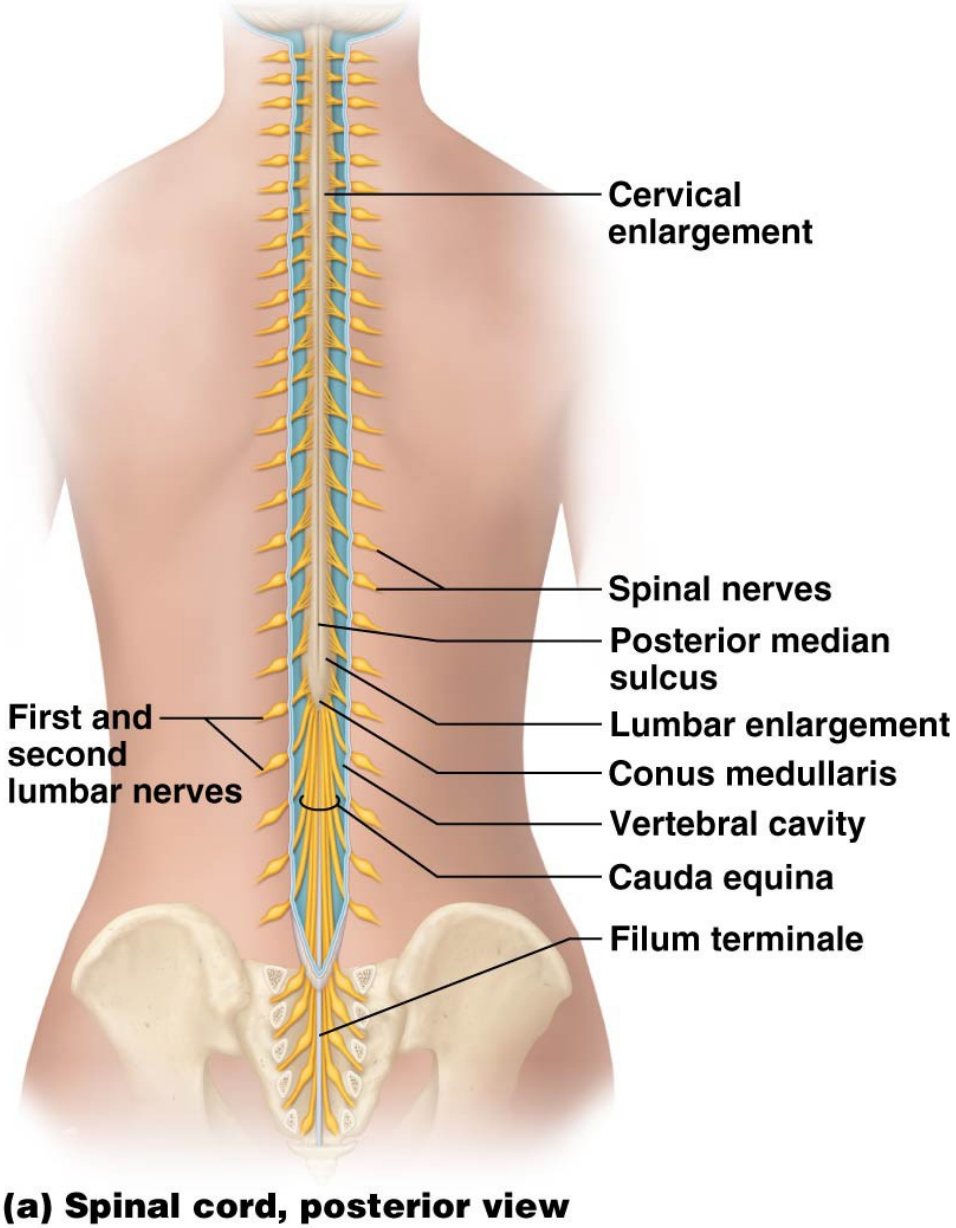
- Contains cerebrospinal fluid (CSF)
  - Left and right lateral ventricles
  - Third ventricle
  - Fourth ventricle
- CSF makes brain buoyant and prevents it from crushing itself
- It is produced in the choroid plexus



Spinal Cord

- Spinal cord
  - Plays a vital role in reflex activity
  - provides neural pathways to and from higher nervous centers

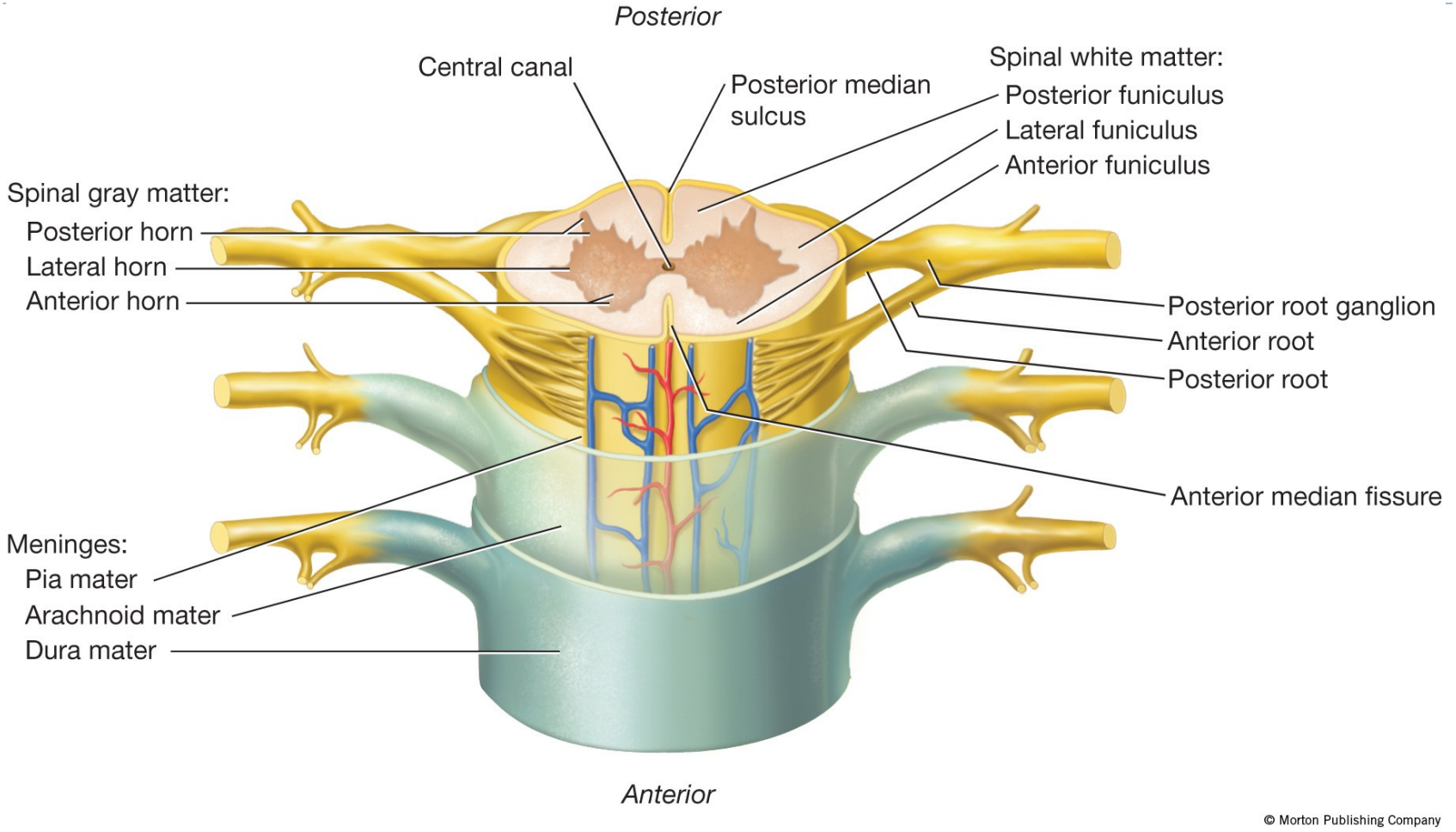




(a) Spinal cord, posterior view

Lab Activity 12B, Figure 12.18-12.20, pg. 341-342

Spinal Cord



- **Lab Activity 12B, Figure 12.18-12.20, pg. 341-342**

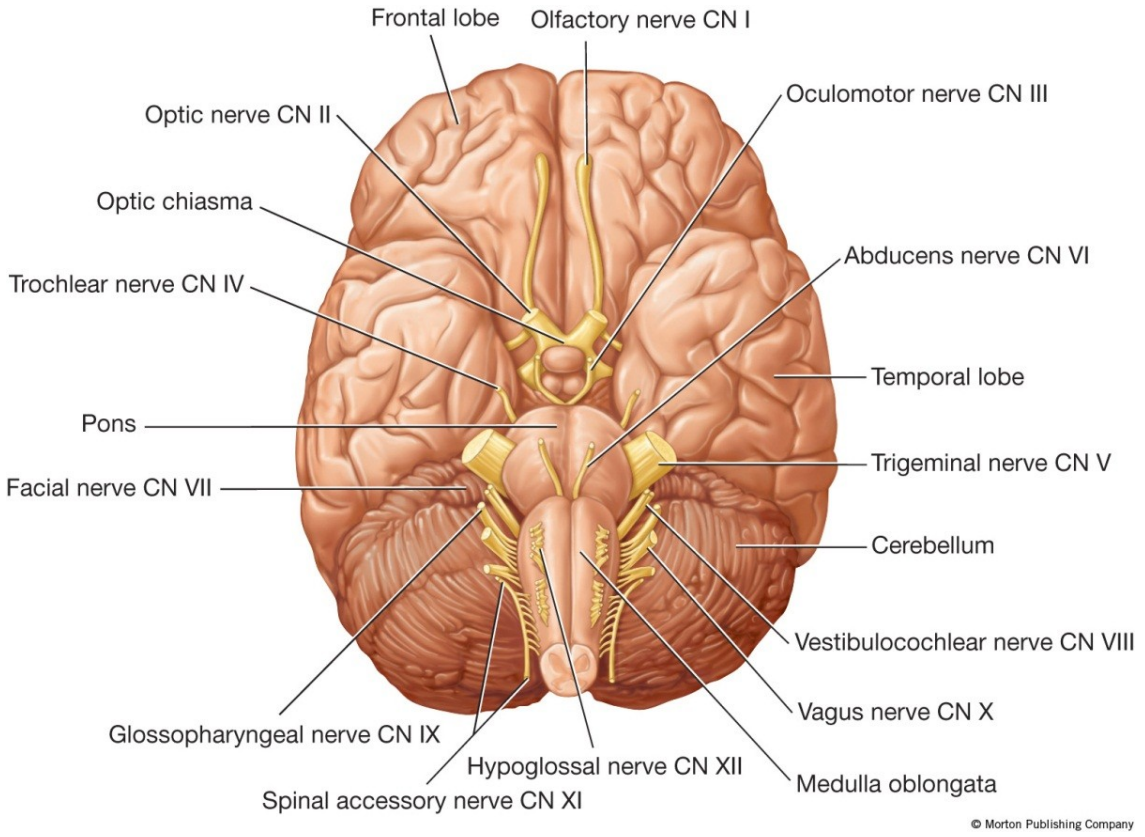
Activities

- Book Activities
  - 11A
    - Procedure 1 and 2
      - Pg. 315-317
      - Pearson Study Area → PAL → Histology → Nervous Tissue
  - 11B
    - Procedure
      - Pg. 320
  - 12A
    - Procedure 1
      - Pg. 336-340
    - Procedure 2: Sheep brain dissection
      - Pearson Study Area → PAL → Cat → Nervous System
        - You will need to know all terms from 12.13-12.17
  - 12B
    - Procedure
      - Pg. 343-345
- Online Activities
  - Complete Pearson Activities

Unit 13: Peripheral Nervous System

Cranial Nerves

- 12 nerves that originate from the brain or brainstem
  - numbered consecutively with different functions
- You need to know all 12 cranial nerves on human models and figures
  - Identification, number, name, function (sensory, motor, or both)



Lab Activity 13A, Table 13.1-13.5, Figure 13.3-13.5, pg. 354-365

Cranial Nerves

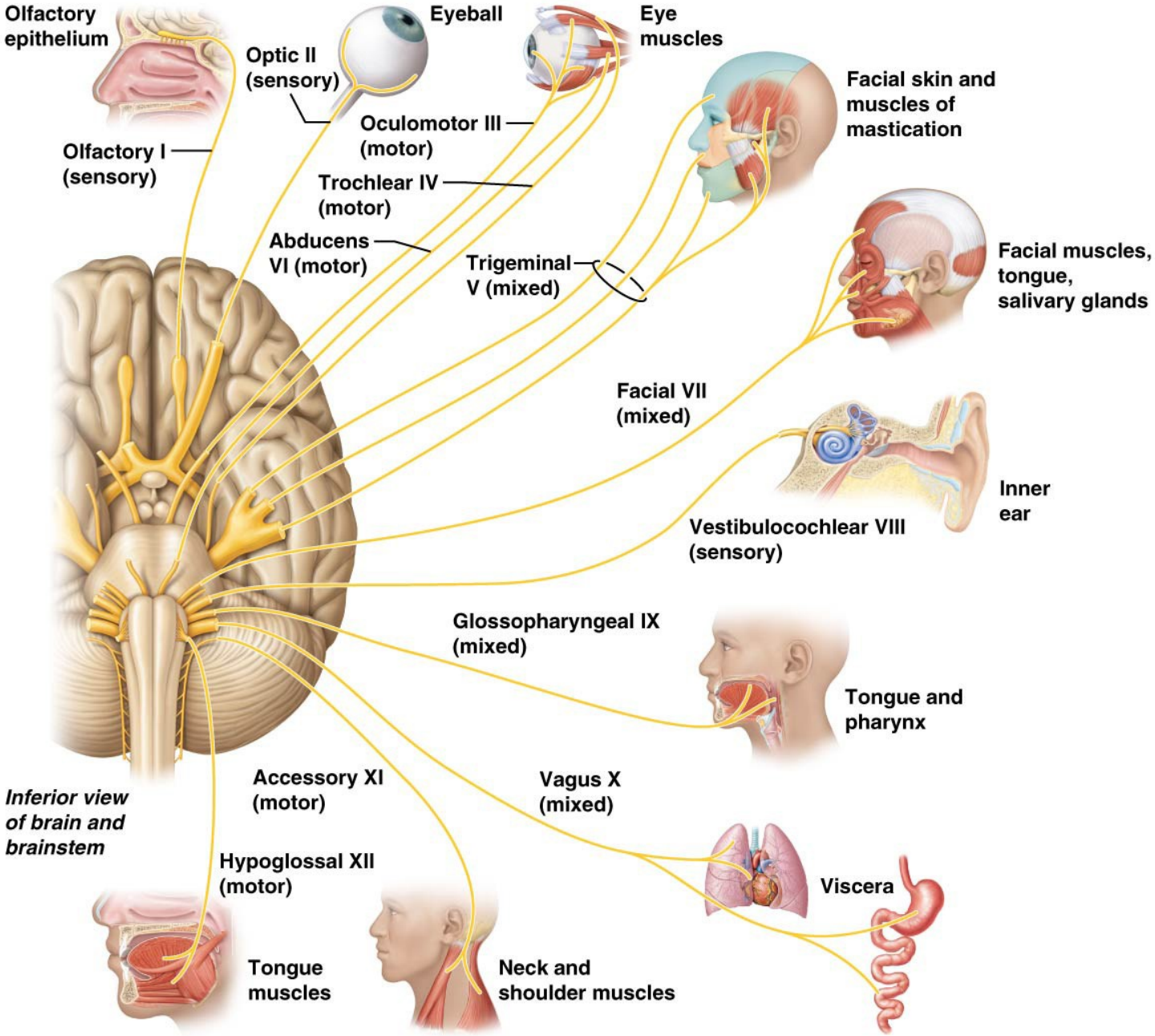
I	Olfactory	Oh
II	Optic	Oh
III	Oculomotor	Oh
IV	Trochlear	The
V	Trigeminal	Touch
VI	Abducens	And
VII	Facial	Feel of
VIII	Vestibulocochlear	Very
IX	Glossopharyngeal	Good
X	Vagus	Velvet,
XI	Accessory	AH
XII	Hypoglossal	HHHH!

- **Lab Activity 13A, pg. 355**

Cranial Nerves

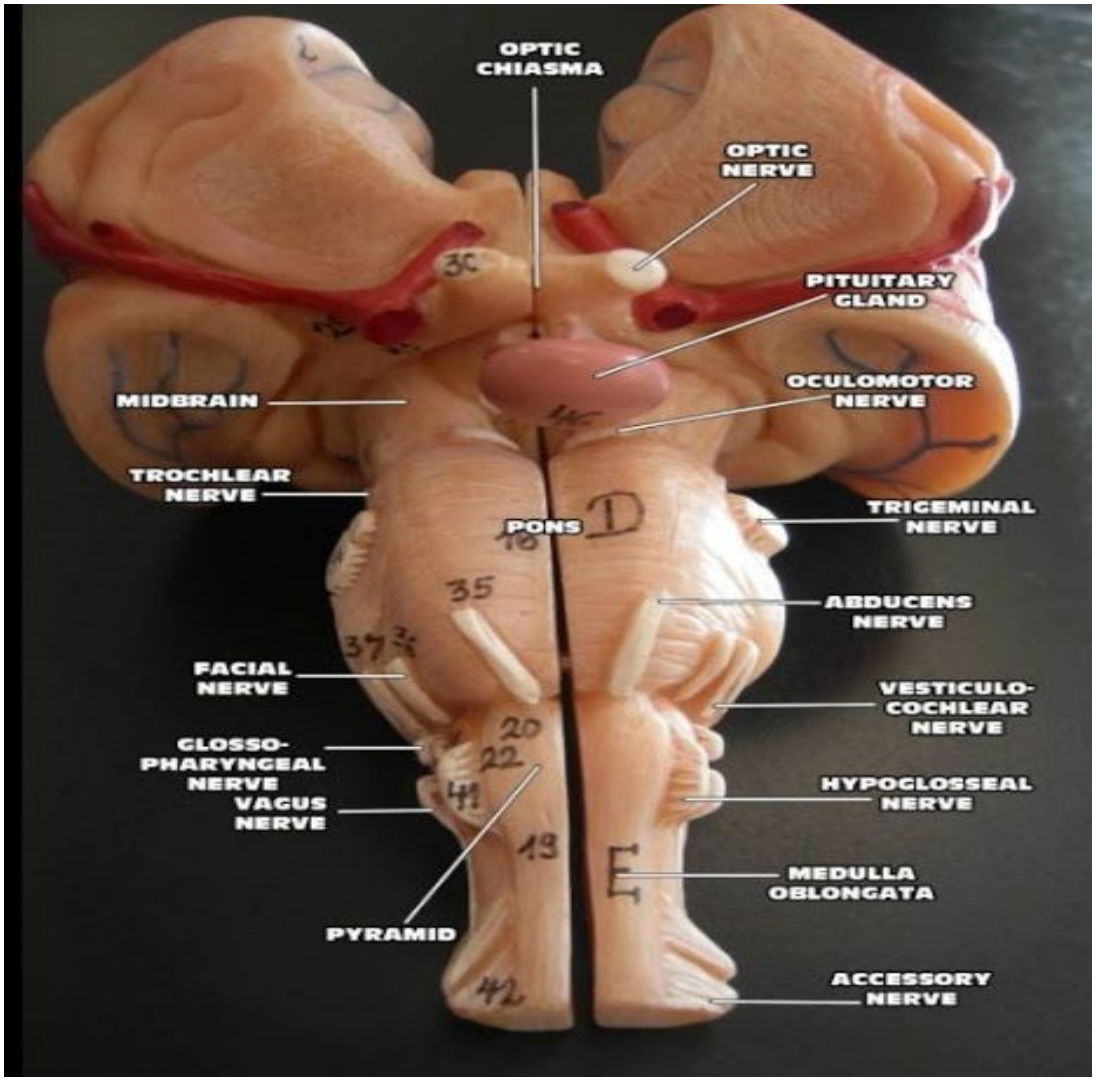
I	Olfactory	Sensory	Some
II	Optic	Sensory	Say
III	Oculomotor	Motor	Marry
IV	Trochlear	Motor	Money
V	Trigeminal	Both	But
VI	Abducens	Motor	My
VII	Facial	Both	Brother
VIII	Vestibulocochlear	Sensory	Says
IX	Glossopharyngeal	Both	Big
X	Vagus	Both	Brains
XI	Accessory	Motor	Matter
XII	Hypoglossal	Motor	More

Lab Activity 13A, pg. 355



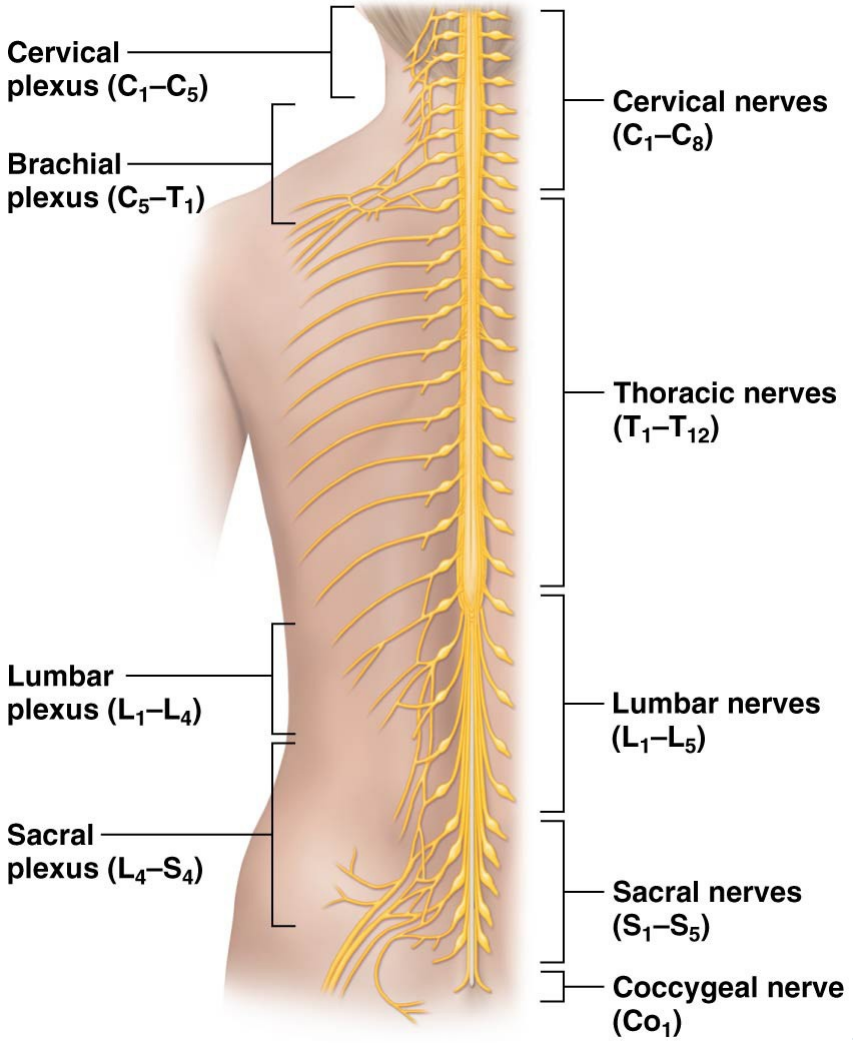
- **Lab Activity 13A, Table 13.1-13.5, Figure 13.3-13.5, pg. 354-365**

1. **Olfactory (I)** – The Smell Detective
   Sniffs out every scent. No perfume, cologne, or pizza goes unnoticed with Olfactory around!
2. **Optic (II)** – The Eagle-Eye
   Sees everything. If you think you can sneak past, think again – Optic's got 20/20 vision!
3. **Oculomotor (III)** – The Eye Mover
   Eye rolls? Check. Looking up, down, and around? That's Oculomotor's gig.
4. **Trochlear (IV)** – The Shifty One
   Handles those precise, downward eye movements. Trochlear keeps your gaze locked on the small stuff.
5. **Trigeminal (V)** – The Face Sensation Expert 😆
   Big on touching and feeling – handles face sensations like a pro, plus has a thing for chewing gum.
6. **Abducens (VI)** – The Side-Eye Specialist 😒
   Ever thrown a side-eye? That's Abducens at work. It pulls the eyes outward for the perfect "seriously?" look.
7. **Facial (VII)** – The Expression Artist
   Smile, frown, pout – Facial's got all the feels. Also, a connoisseur of taste, especially sweet and salty.
8. **Vestibulocochlear (VIII)** – The Balance Buddy
   Keeps you steady and rocking! Handles balance and lets you enjoy your favorite tunes.
9. **Glossopharyngeal (IX)** – The Tongue Talker
   From swallowing to tasting, Glossopharyngeal is all about flavor and throat skills.
10. **Vagus (X)** – The World Traveler
    This nerve wanders far and wide, helping with digestion, heart rate, and just about everything below the neck.
11. **Accessory (XI)** – The Shoulder Shrugger
    Controls shoulder shrugs and head turns. Think of it as the "whatever" nerve – makes it easy to say, "I don't know."


OPTIC CHIASMA
OPTIC NERVE
PITUITARY GLAND
MIDBRAIN
OCULOMOTOR NERVE
TROCHLEAR NERVE
PONS
TRIGEMINAL NERVE
ABDUCENS NERVE
FACIAL NERVE
VESTICULO-COCHLEAR NERVE
GLOSSO-PHARYNGEAL NERVE
VAGUS NERVE
HYPOGLOSSEAL NERVE
MEDULLA OBLONGATA
PYRAMID
ACCESSORY NERVE

Spinal Nerves

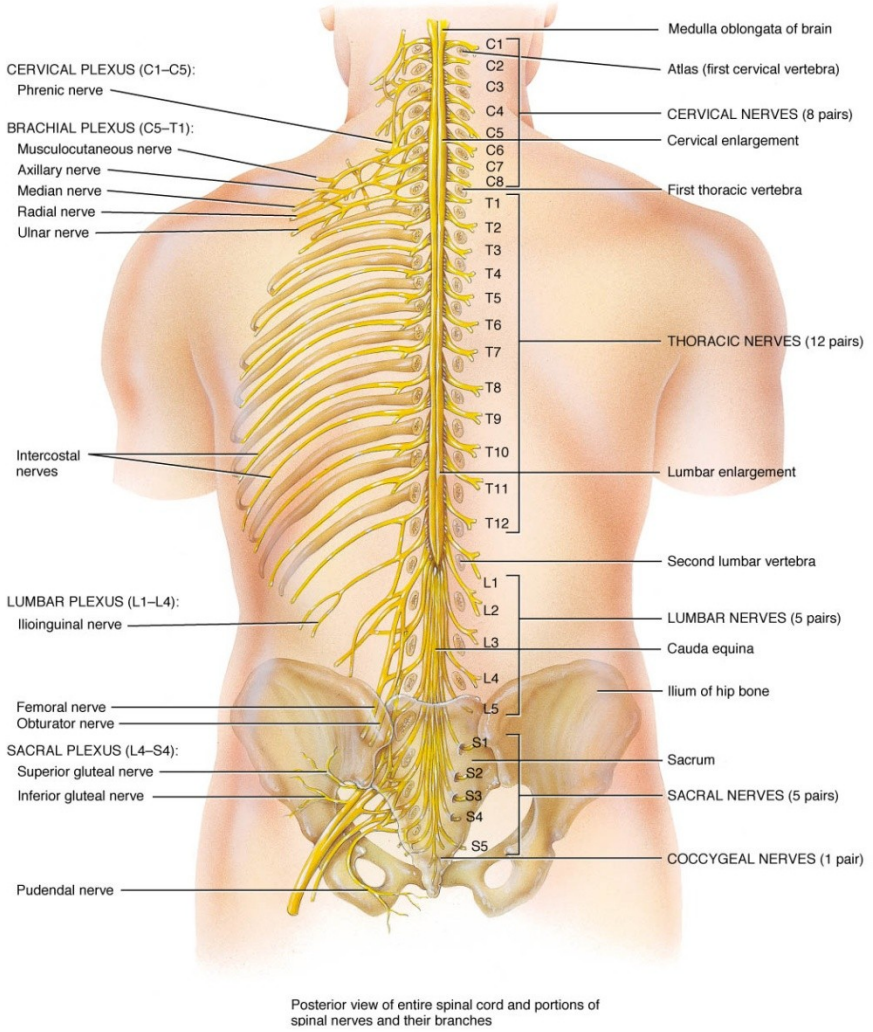
- Spinal Nerves just like vertebrae have divisions
  - 31 pairs of spinal nerves
    - 8 cervical (C1–C8); C1 between skull and atlas
    - 12 thoracic (T1–T12)
    - 5 lumbar (L1–L5)
    - 5 sacral (S1–S5)
    - 1 coccygeal (Co)



Lab Activity 13B, Figure 13.6-13.12, pg. 365-371

Spinal Nerves

- Spinal nerves
  - Brachial plexus
    - Brachial/ axillary areas
      - Innervates the upper limb
      - Roots form trunks, divisions, and cords
      - Roots
        - C5 – T1
      - Trunks
        - Upper
        - Middle
        - Lower
      - Divisions
        - Anterior
        - Posterior
      - Cords
        - Lateral
        - Medial
        - Posterior



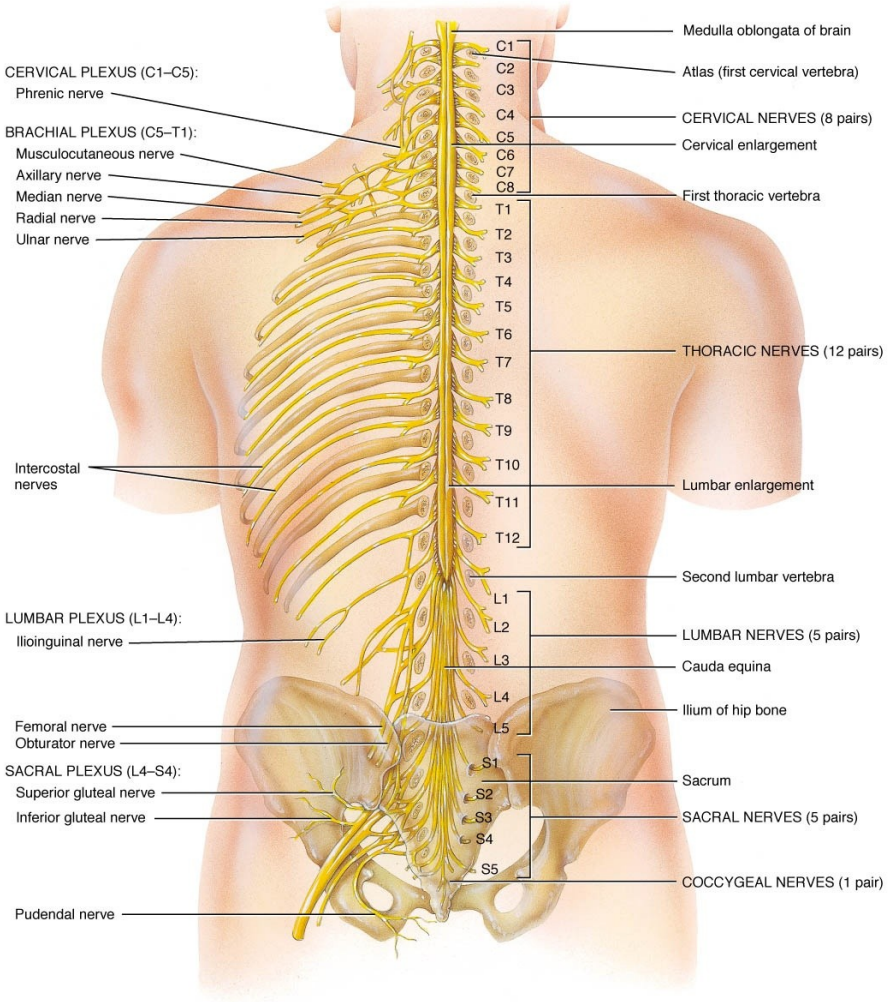
Posterior view of entire spinal cord and portions of spinal nerves and their branches

Lab Activity 13B, Figure 13.6-13.12, pg. 365-371

Spinal Nerves

- Spinal nerves
  - Brachial plexus
  - Nerves
    - Axillary
      - Posterior cord
      - Innervates deltoid and teres minor muscles
    - Musculocutaneous
      - Lateral cord
      - Innervates biceps brachii, brachialis, and corocobrachialis
    - Median
      - Medial cord
      - Innervates flexor muscles of forearm
        - Lateral palm
    - Ulnar
      - Medial cord
      - Innervates flexor carpi ulnaris and flexor digitorum profundus
        - Flexes phalanges
    - Radial
      - Posterior cord
        - Innervates most extensor muscles of the upper limb

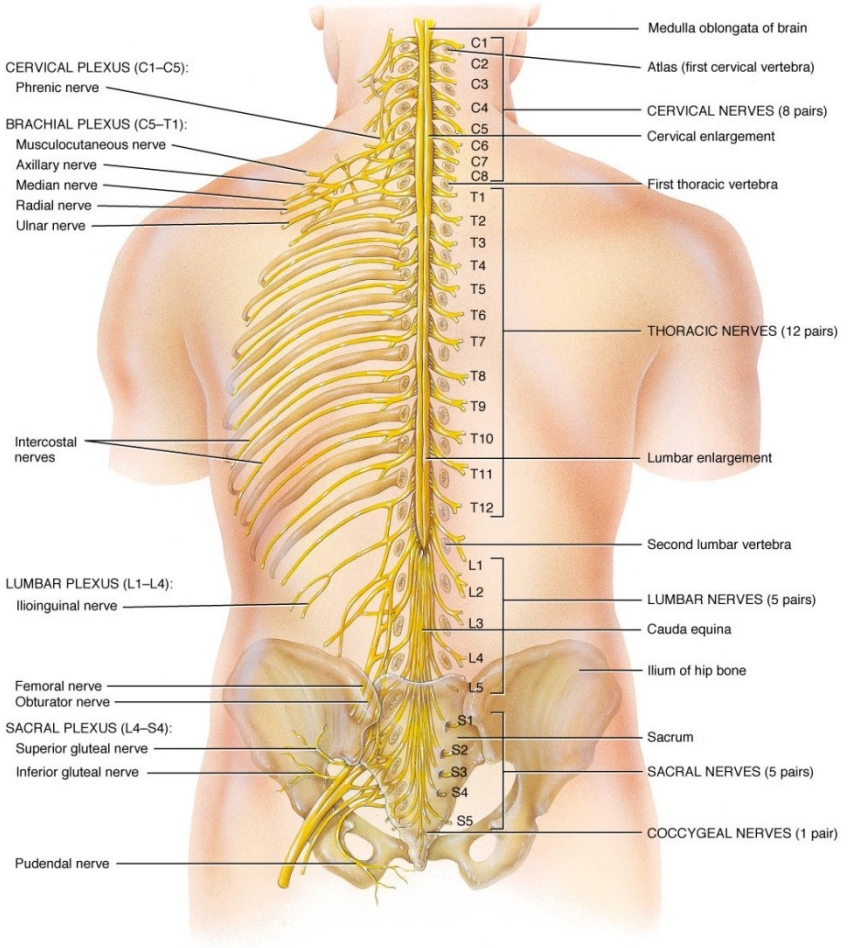
Lab Activity 13B, Figure 13.6-13.12, pg. 365-371



Posterior view of entire spinal cord and portions of spinal nerves and their branches

Spinal Nerves

- Lumbosacral plexus
  - Lumbar plexus
    - Spinal nerves L1 – L4
    - Nerves
      - Femoral nerve
        - Innervates the quadriceps muscles
      - Obturator nerve
        - Innervates the adductor muscles

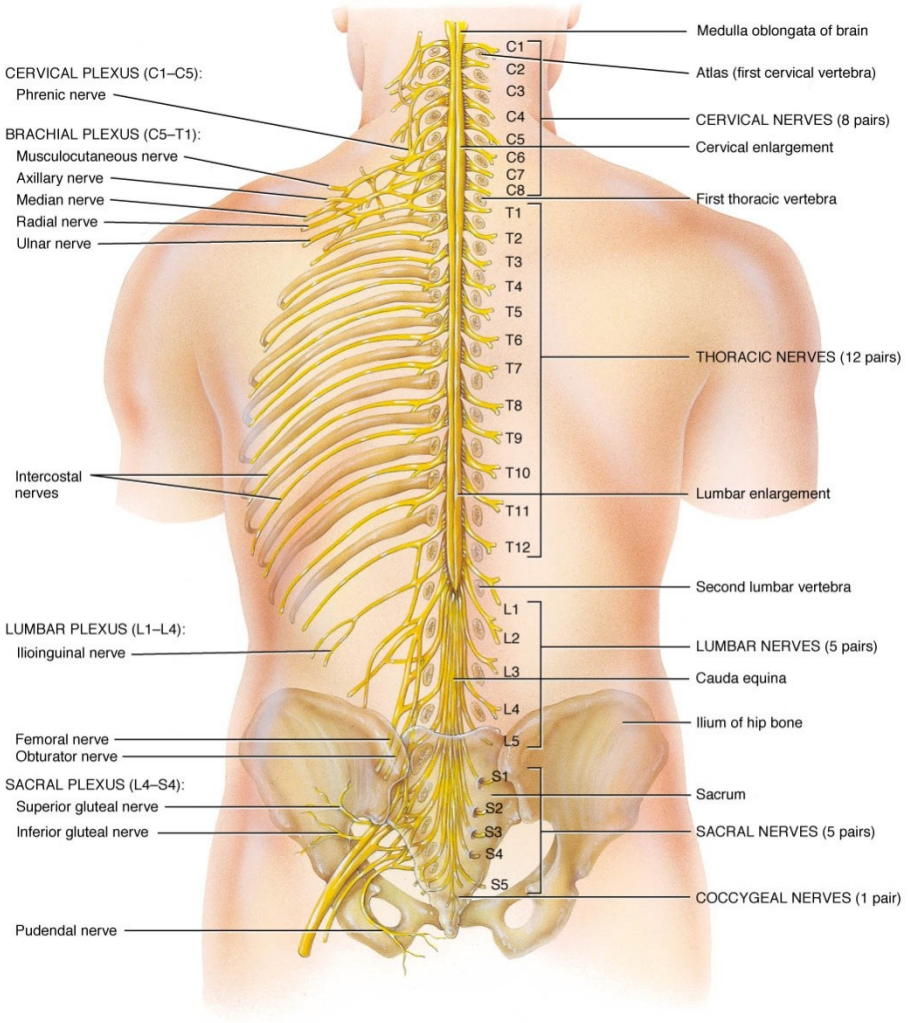


Posterior view of entire spinal cord and portions of spinal nerves and their branches

Lab Activity 13B, Figure 13.6-13.12, pg. 365-371

Spinal Nerves

- Spinal nerves
  - Sacral plexus
    - Spinal nerves L4 – S4
    - Nerves
      - Sciatic
        - Tibial and common fibular nerves in one sheath
      - Tibial
        - Supplies the posterior compartment muscles
        - Sural nerve
        - Medial and lateral plantar nerve
      - Common fibular nerve
        - Innervate knee joint
      - Superior and inferior gluteal nerves
        - Innervate the gluteal muscles
      - Pudendal nerve
        - Innervates the perineum
  - Thorax
    - Intercostal nerves
      - T1 – T12
      - Supply the intercostal muscles

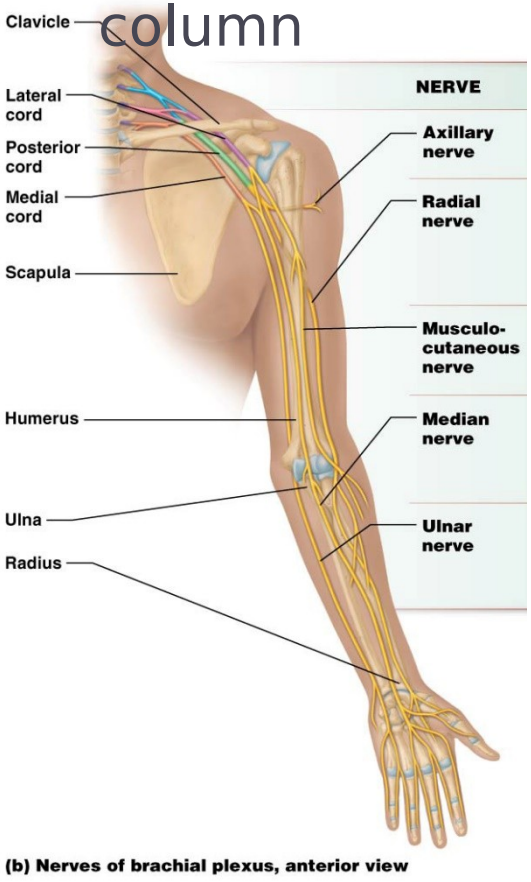


Posterior view of entire spinal cord and portions of spinal nerves and their branches

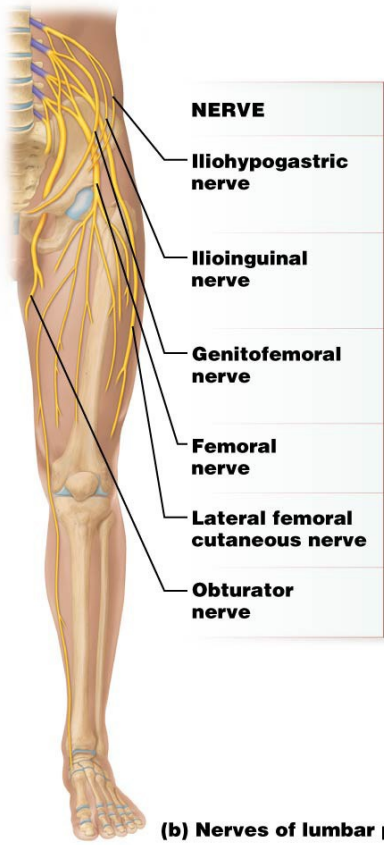
Lab Activity 13B, Figure 13.6-13.12, pg. 365-371

Spinal Nerves

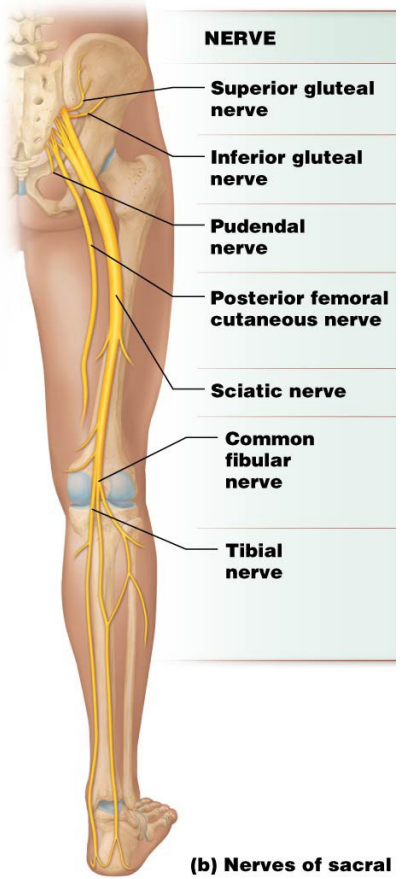
- Nerve Plexuses
  - nerve networks, located lateral to the vertebral column



(b) Nerves of brachial plexus, anterior view

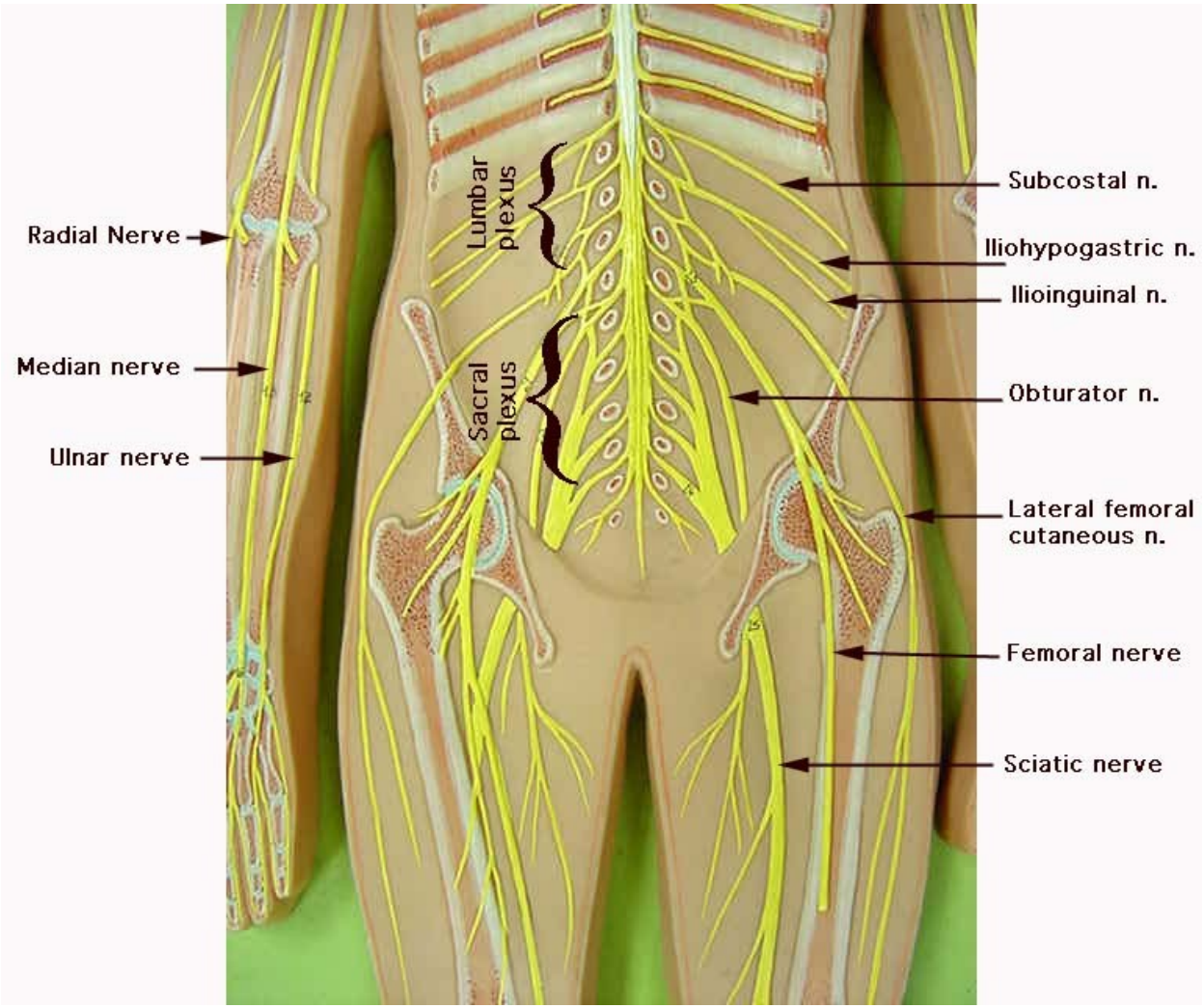


(b) Nerves of lumbar



(b) Nerves of sacral

Lab Activity 13B, Figure 13.6-13.12, pg. 365-371


Radial Nerve
Median nerve
Ulnar nerve
Lumbar plexus
Sacral plexus
Subcostal n.
Iliohypogastric n.
Ilioinguinal n.
Obturator n.
Lateral femoral cutaneous n.
Femoral nerve
Sciatic nerve

Activities

Lab Activity 13A, Table 13.1-13.5, Figure 13.3-13.5, pg. 354-365

Lab Activity 13B, Figure 13.6-13.12, pg. 365-371

Online Activities:

Complete Pearson Activities